ORIGINAL RESEARCH

National Study of Ambulance Transports to United States Emergency Departments: Importance of Mental Health Problems

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Abstract

Introduction: Understanding ambulance utilization patterns is essential to assessing prehospital system capacity and preparedness at the national level.

Objective: To describe the characteristics of patients transported to US emergency departments (EDs) by ambulance and to determine predictors of ambulance utilization.

Methods: Data were obtained from the National Hospital Ambulatory Medical Care Survey using mode of arrival, demographic and visit information, ICD-9-CM E and V-codes, and classified reasons for the visit.

Results: The rates for ED visits of persons conveyed by ambulence were stable between 1997 and 2003, consisting of approximately one in every seven ED visits (14%). In 2003, there were 16.2 million ED visits for which an ambulance was used in the US. However, for patients with mental health visits, nearly one in three ED presentations (31%) arrived by ambulance. Significantly higher rates of ambulance use were associated with: (1) mental health visits; (2) older age; (3) African-Americans; (4) Medicare or self-pay insurance status; (5) urban ED location; (6) US regions outside of the South; (7) presentation between 12 midnight to 0800 hours; (8) injury-related visits; (9) urgent visit status; and/or (10) those resulting in hospital admission. Among mental health patients, older age, self-pay insurance status, urban ED location, regions outside the southern US, and urgent visit classification predicted ambulance use. Ambulance usage within the mental health group was highest for suicide and lowest for mood and anxiety disorder-related visits.

Conclusion: Reliance on ambulance services varies by age, insurance status, geographic factors, time of day, urgency of visit, subsequent admission status, and type of mental health disorder. Even after controlling for many confounding factors, mental health problems remain an important predictor of ambulance use.

Introduction

Of the 114 million visits to US emergency departments (EDs) in 2003, an estimated 16 million arrived by ambulance (14%).[1] Given that basic ambulance transport average charges equal [US] $550–660 per trip, emergency medical services (EMS) transports to the ED cost the nation almost $10 billion annually.[2–4] In the context of ever-increasing EMS demand, ED closures and overcrowding have placed serious compensatory strains on existing prehospital resources, resulting in longer transport times, increased members of ambulance diversions, and longer out-of-service times for individual units.[5–7]

A number of studies have examined the relationship between system-specific predictors and ambulance use in narrowly defined service areas,[8–11] but there is a paucity of national, population-based data on ambulance utilization.[12] A Boston study by Rucker *et al* examined patient-specific predictors of ambulance use among non-mental health patients, and found that managed care insurance status, clinical severity, and older age were associated positively with increased usage.[13]

More inclusive, epidemiologically based, ED studies suggest that mental-health patients often rely on prehospital care while psychiatric visits constitute an increasing burden on emergency services nationwide.[14] Some authors have suggested that patients with mental illness are over-represented among ED ambulance referrals as they allegedly abuse or misuse EMS services.[15–19] A study from Australia showed that the strongest predictors of ambulance use in Brisbane were >65 years of age and were experiencing a mental health condition.[20] In San Diego County, California, psychiatric problems have been listed among the most prevalent chief complaints for both emergency and non-emergency ambulance transports for five continuous years (1999-2004).[21] To date, no large studies have examined the specific predictors of ambulance usage among mental health patients presenting to an ED, an epidemiologically important and rapidly growing subgroup of consumers seeking emergency care.

The purpose of this paper is to examine both demographic and clinical correlates of ambulance utilization for a national, population-based sample of ED visits. Also, the predictors of overall ambulance utilization are identified and the subgroups of ED patients with mental disorders are described.

Methods

Initiated in 1992 as part of the ambulatory component of the National Health Care Survey, the National Hospital Ambulatory Medical Care Survey (NHAMCS) assesses ED and outpatient department utilization by employing a four-stage probability sample of visits to non-institutional, general and short-stay hospitals in the US.[1,22] Conducted annually, the NHAMCS covers geographic, primary sampling units, hospitals within primary sampling units, EDs within hospitals, and patients within the EDs. Trained hospital staff from participating institutions collect and code data during a four-week period for each of the sampled hospitals on a 16-month, rotating cycle.[23] National estimates are obtained through the use of a multi-stage, estimation procedure that weighs patient visits and includes three basic components: (1) inflation by reciprocals of the sampling selection probabilities; (2) adjustment for non-response; and (3) a population weighting-ratio adjustment. Quality control includes computer checks to assess inconsistencies with value ranges at the central data entry site, a two-way, 10% independent procedure for medical and drug coding, and adjudication by the National Center for Health Statistics (NCHS) for ambiguous or illegible responses for fields including reasons for visit and diagnosis. The non-response rate for items generally is <5%, and error rates are <2% for items that require medical coding.[24]

Utilizing the ED component of the NHAMCS, mental health-related ED visits were included if their records met any one of three criteria: (1) DSM-IV-TR-based, major mental health problems (ICD-9-CM diagnoses 290.0-305; 307-310; 311-319.0 or V-codes 61.1-71.02 in any of the three available diagnosis fields); (2) NCHS-assigned Patient Reason-for-Visit Classification codes related to mental health in any of the three reason for visit fields,[23–25]

1100.0-1199.9; and/or (3) injury E-codes related to suicide in any of the three injury E-code fields, E950.0-E959.9. Otherwise, visits that did not meet at least one of the above criteria were deemed non-mental-health visits. Those ICD-9-CM codes in the 290–319 ranges were excluded if they were in the following categories: (1) psychosexual disorders (ICD 302); (2) sleeping disturbances (ICD 307.4); (3) physiological malfunction (ICD 306); (4) post-concussive syndrome (ICD-310.2); (5) non-dependent tobacco-use disorder (ICD 305.1); and (6) enuresis and encopresis (ICD 307.6, 307.7). Mental health-related ED visits were assigned specific DSM IV-compatible categories as listed in the Appendix.

For the NHAMCS "mode of arrival" variable for all major years contained in these analyses, <5% of the data were missing. Cases were analyzed by age, gender, race, ethnicity, insurance status, location in a metropolitan statistical area (MSA), and region of the US (Northeast, Midwest, South, and West). Metropolitan statistical areas and US regional categories as used here represent standardized geographical divisions defined by the US Census Bureau.[26] Visits were analyzed further by time and day of presentation, admission status, injury-related visit (defined by ICD-9-CM Injury and Poisoning E-Codes and Reason for Visit Classification) and NHAMCS-defined urgency ("urgent/emergent" or "nonurgent") at triage. Visits were considered "urgent" if expected triage time was recorded as ≤ 1 hour.

All analyses were performed using STATA 9.0 (StataCorp, College Station, Texas). A masked, ultimate, cluster sample design was used to estimate variance. In accordance with NCHS recommendations, only estimates with a relative standard error of <30% and observations >29 are reported. A non-parametric trend test was performed to examine trends over time. Weighted logistic regression was performed to obtain odds ratios (OR) and 95% confidence intervals (95% CI). To examine the stability of the two final multivariate models, they were tested using 1997 data and the results did not differ materially (data not shown). Two-sided p-values <0.05 were considered statistically significant.

Results

Between 1997 and 2003 inclusive, ambulance utilization remained stable between 14 and 15% for all ED patients (p_{trend} = 0.32). As illustrated in Figure 1, the absolute number of patient visits by ambulance increased even though this proportion of ambulance-related visits remained stable, since the overall number of ED visits continued to rise. Because there was no statistically significant change in the rate of ambulance utilization, all subsequent analyses were focused on all 12 months of 2003 data, the most recent year of NHAMCS available.

There were 16.2 million ambulance visits to the EDs in 2003. Of the 114 million emergency department (ED) visits in the US, approximately one in seven (14%) arrived via ambulance. For the 7.4 million mental health patients, however, nearly one in three (31%) used an ambulance in order to access the ED.

The characteristics of ambulance users versus non-ambulance users are listed in Table 1. Patients arriving by
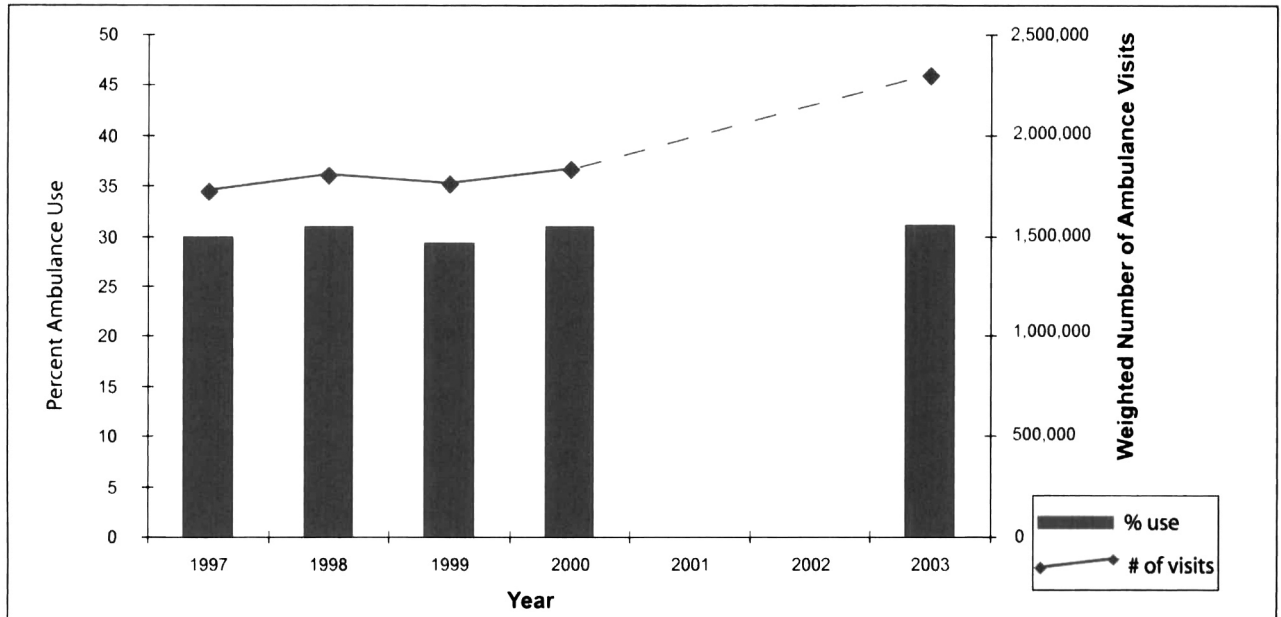
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Figure 1—Mental health ambulance visit trends (# = number; Data not available for 2001, 2002)

ambulance tended to be older, of Caucasian, non-Hispanic race/ethnicity, and had public rather than private insurance. Ambulance users also were more likely to be from an urban area and from a US region outside of the South. They were more likely to arrive during the night, have medical conditions classified as requiring "urgent" care at triage, visit the ED for an injury, and to be admitted to the hospital (all p <0.05). Multivariate predictors for ambulance use among all ED patients are listed in Table 2. Mental health visits were a significant predictor of ambulance usage.

Among patients admitted to US EDs with mental health problems, selected demographic and visit-related descriptors, and their respective age-adjusted odds ratios, by ambulance utilization status are listed in Table 3. Substance and suicide-related visits were 1.8 and 2.6 times (respectively) more likely than were any other ambulance visits. Mental health patients between 60 and 74 years of age were 6.7 times more likely, and patients >75 years were 11.7 times more likely to use the ambulance, compared to patients <15 years. Ambulance users with mental health problems were more likely to arrive between midnight and 0800 hours and tended to have Medicare, self-pay insurance status (versus private), or another insurance provider. Mental health patients in the emergency department are more likely to use an ambulance if their visit is injury-related, or if their visit resulted in admission to the hospital. Urgent classification among mental health patients also was associated with ambulance use. Gender, race/ethnicity, and arrival on a weekend (versus weekday) were not related to ambulance use among visits for mental health reasons.

The results from multivariate logistic regression computed to predict ambulance use among mental health patients are provided in Table 4. Independent predictors included older age, self-pay insurance status, urban location, US regions outside of the South, injury-related visit, and urgent visit classification. Those with an anxiety or

mood disorder were less likely (statistically significant) to arrive by ambulance, while suicide-related visits had a borderline statistically significant increase in ambulance usage in the multivariate model.

Discussion

This is one of the few studies to examine ambulance utilization rates for ED patients in the US using a national probability sample. Most demographic variables other than older age were not predictive of ambulance use. The exponential increase in ambulance use with advanced age is in substantial agreement with other studies.[13,20,27] In a study from Australia, Clark and colleagues documented the importance of age and also found that males had higher rates of prehospital EMS utilization than did females across every age group.[28] The US Centers for Disease Control and Prevention's National Center for Health Statistics reported that in 2003, more than half of all visits for those >85 years of age arrived by ambulance,[29] and prehospital EMS can expect to be increasingly busy servicing an aging American population in the future. No effects of race or ethnicity on ambulance were found in the present analysis. A recent study from Canada, by contrast, found minority ethnicity to be associated with both ambulance and police referrals to an ED, but this was a small, non-population-based report from Montreal that included police and ambulance transports together as one outcome.[15]

As indicated by previous studies, an increased rate of ambulance use was found among those seeking emergency care for mental-health reasons. While this is an epidemiologically important group of emergency service consumers, long suspected of over-using and abusing ambulance services,[14,30] the high urgency (35%) and admission (46%) rates of psychiatric patients in this national sample questions these suspicions. Understanding existing prejudice against psychiatric patients may be important, as a study by

	Ambulance Users		Non-Ambulance Users		
	Weighted n	Weighted (%)	Weighted n	Weighted (%)	*p*-value
Age (years)					
<15	939,240	(5.8)	23,800,000	(24.3)	
15-29	2,487,121	(15.4)	23,600,000	(24.1)	
30-44	2,905,206	(18.0)	21,700,000	(22.2)	*<0.001*
45-59	2,865,584	(17.7)	14,500,000	(14.8)	
60-74	2,724,204	(16.9)	8,089,536	(8.3)	
75+	4,244,062	(26.3)	6,144,793	(6.3)	
Gender					
Female	8,763,226	(54.2)	52,200,000	(53.4)	= 0.46
Male	7,402,191	(45.8)	45,500,000	(46.6)	
Race/Ethnicity					
White non-hispanic	11,000,000	(68.1)	62,300,000	(63.8)	
Black non-hispanic	1,329,387	(8.2)	11,100,000	(11.4)	
Other non-hispanic	3,156,258	(19.5)	19,700,000	(20.2)	<0.01
Hispanic	225,109	(1.4)	1,624,452	(1.7)	
Missing ethicity	438,659	(2.7)	2,891,970	(3.0)	
Insurance					
Private	3,806,641	(23.5)	37,700,000	(38.5)	
Medicare	8,440,168	(52.2)	34,500,000	(35.3)	
Medicaid	708,306	(4.4)	5,335,531	(5.5)	<0.001
Self-pay	2,126,533	(13.2)	13,900,00	(14.3)	
Other	1,083,769	(6.7)	6,307,861	(6.5)	
Urbanicity					
Urban	13,800,000	(85.2)	79,100,000	(80.9)	<0.001
Non-urban	2,392,597	(14.8)	18,700,000	(19.1)	
Region					
Northeast	4,036,015	(25.0)	19,800,000	(20.2)	
Midwest	3,976,712	(24.6)	21,200,000	(21.7)	<0.01
South	5,327,341	(33.0)	39,600,000	(40.5)	
West	2,825,349	(17.5)	17,100,000	(17.5)	
Time of Day					
00:00-07:59 h	3,123,174	(19.5)	14,100,00	(14.7)	
08:00-15:59 h	6,895,756	(43.1)	40,500,000	(41.9)	<0.001
16:00-23:59 h	5,965,795	(37.3)	41,900,000	(43.4)	
Day					
Weekend	4,600,694	(28.5)	29,200,000	(29.9)	= 0.11
Weekday	11,600,000	(71.5)	68,500,000	(70.1)	
Visit Type					
Mental health	6,089,405	(14.2)	5,099,707	(5.2)	<0.001
Injury-related	6,579,371	(40.7)	33,600,000	(34.4)	<0.001
Urgent	10,800,000	(82.2)	45,100,000	(56.9)	<0.001
Admitted	6,089,405	(37.7)	10,000,000	(10.3)	<0.001

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Table 1—Characteristics of ambulance users versus non-ambulance users among all emergency department patients

		Odds Ratio	95% CI
Age (10-year increments)		1.32	1.3-1.4
Male		0.95	0.8-1.1
Race (white reference)			
	Black	1.24	1.1-1.4
	Other race	0.97	0.7-1.3
	Hispanic ethnicity	1.06	0.9-1.3
Insurance (private reference)			
	Medicare	1.58	1.4-1.8
	Medicaid	1.25	0.9-1.7
	Self-pay	1.56	1.3-1.8
	Other	1.88	1.5-2.4
Urban		1.46	1.2-1.7
Northeast (reference)			
	Midwest	1.03	0.8-1.4
	South	0.71	0.6-0.9
	West	0.85	0.6-1.1
Time (12:00-08:00 h reference)			
	08:00-16:00 h	0.65	0.6-0.8
	16:00-00:00 h	0.64	0.5-0.7
Weekend		1.01	0.9-1.1
Mental health visit		2.33	2.0-2.7
Injury-related visit		1.99	1.8-2.2
Urgent		2.66	2.2-3.2
Admit		2.95	2.6-3.4

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Table 2—Multivariate logistic regression: Predictors of ambulance use among all emergency department patients (CI = confidence interval; h = hours)

Schmidt et al suggested that EMS workers commonly and systematically under-triage patients with mental health problems.[31] The observation that mental health visits have higher urgency and admission rates, yet longer waiting times, may reflect a similar bias against such patients.

In contrast to non-mental health-related ED visitors, the proportion of male and female ambulance users among mental health patients in this study was equivalent when controlling for other factors. Similarly, multivariate analysis indicated that there were no rural and urban differences in ambulance demand for mental health patients. Ambulance use by mental health patients was lowest in the South. Prior studies have noted a lower density of board-certified psychiatrists per capita in the Northeast,[14] but smaller area variation analysis would be required to further explicate this observation.[32-34] Amidst threats of disaster and increased ambulance diversions due to ED closures and overcrowding, it is imperative that policy makers better understand the variations in demand for pre-hospital services.[35,36]

As with many older studies of ambulance utilization, non-private or self-pay insurance status was found to be predictive of EMS-ED transport among mental health, as well as non-mental health ED attendees.[9,11,12] While examining non-mental health patients, Rucker et al (1997) also found that traditional indemnity plans or privately insured patients used ambulance services the least.[13] Privately insured patients are likely to have alternative means of transportation; however, this finding also may be related to service gaps in mental health care delivery for self-pay patients and insurance coverage exclusion under many publicly funded and managed care arrangements for mental health.[37]

Ambulance use also was predicted by late night arrival to the ED (12 midnight to 08:00h), which may be related to the lack of public transportation alternatives at these times, as well as the higher acuity of overdose and substance abuse patients who typically arrive at night, intoxicated. Visits classified as injury-related also were more likely to require EMS services, and this includes self-poisoned and intentionally self-harming patients who are admitted involuntarily.

While anxiety-related visits were the least likely to use an ambulance, both substance abuse and suicide-related visits were highly predictive of ambulance transport. These data support the previously documented finding of increased ambulance use by those suffering from a substance-related disorder.[17,38-40]

There are several potential limitations to this analysis. The selection of candidate predictors was limited by what was collected in the NHAMCS. Acuity could not be measured or controlled. Therefore, it is impossible to assess who truly needed an ambulance and who did not, although it may be surmised that those visits identified as urgent and those ultimately admitted generally were more worthy of ambulance conveyance than others. In addition, the use of administrative databases to assign diagnoses, including mental-health diagnoses, may be problematic.[41] Others have shown that even highly trained emergency physicians can be poor at making accurate mental-health diagnoses. Therefore, the results of this study may under-represent these ED visits.[42-45] In order to control for systematic under-counting, patient-reported reason for visit and physician-identified injury E-codes were included to encompass as many mental health patient visits as the data would allow. Prior work in assessing occult mental-health problems suggests that under-counting is more likely than is over-counting for ED-identified mental health visits.[46]

Conclusion
In summary, the actual numbers of ED-related ambulance transports are rising, although they comprise a stable proportion of all ED visits over time. Ambulance use is associated with age, insurance, urbanicity, time of day, and surrogate markers of acuity, urgency, and admission. Usage also is associated with mental health problems—a significant issue in the wake of disasters or mass casualty incidents. For mental health-related visits, many of the same predictors of ambulance use apply, and patients with substance- or suicide-related visits were found to use ambulances more frequently than do those presenting for care of other disorders. Conversely, patients with anxiety disorders were least

	Mental Health % Ambulance Use		Age-adjusted Odds Ratio	
	Weighted n	Weighted (%)	Odds Ratio	95% CI
Age (years)				
<15	60,117	(9.7)		
15-29	464,227	(25.3)	3.17	1.76-5.70
30-44	618,211	(28.8)	3.79	2.04-7.03
45-59	525,345	(34.6)	4.94	2.67-9.16
60-74	245,405	(41.8)	6.71	3.58-12.59
75+	384,709	(55.6)	11.72	6.14-22.37
Gender				
Female	1,146,247	(31.1)		
Male	1,151,767	(31.0)	1.09	0.86-1.38
Race/Ethnicity				
White non-hispanic	1,511,076	(30.2)		
Black non-hispanic	215,246	(28.3)	1.10	0.79-1.55
Other non-hispanic	467,989	(36.3)	1.41	1.06-1.86
Hispanic	42,425	(31.0)	1.23	0.61-2.47
Missing ethnicity	61,278	(28.6)	0.98	0.55-1.76
Insurance				
Private	464,606	(23.4)		
Medicare	1,084,922	(35.6)	1.44	1.08-1.92
Medicaid	90,961	(29.1)	1.32	0.74-2.36
Self-pay	447,992	(31.6)	1.64	1.19-2.27
Other	209,533	(33.1)	1.58	1.04-2.39
Urbanicity				
Urban	1,994,398	(32.3)		
Non-urban	303,616	(24.7)	0.63	0.46-0.87
Region				
Northeast	614,486	(33.0)		
Midwest	481,740	(32.4)	1.02	0.71-1.47
South	669,510	(27.5)	0.75	0.53-1.06
West	532,278	(33.0)	1.00	0.71-1.42
Time of Day				
00:00-07:59 h	441,729	(32.4)		
08:00-15:59 h	853,680	(30.1)	0.72	0.53-0.97
16:00-23:59 h	954,777	(31.6)	0.90	0.66-1.22
Day				
Weekend	625,462	(31.7)	1.06	0.83-1.35
Weekday	1,672,552	(30.8)		
Visit Type				
Anxiety	273,554	(18.1)	0.39	0.28-0.54
Mood	403,639	(22.1)	0.66	0.51-0.85
Psychosis	244,487	(32.5)	0.99	0.72-1.35
Substance	904,736	(38.2)	1.76	1.38-2.24
Suicide	240,687	(44.7)	2.64	1.79-3.88
Injury-related	1,219,447	(39.2)	2.28	1.85-2.80
Urgency	1,486,096	(35.1)	2.00	1.47-2.73
Admit	819,988	(46.3)	1.28	1.07-1.53

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Table 3—Mental health patients: Percent ambulance use (CI = confidence interval; h = hours; n = number)

	Odds Ratio	95% CI	
Age (10-year increments)	1.3	1.2	1.4
Male	0.8	0.6	1.1
Race (white reference)			
Black	1.2	0.8	1.7
Other race	1.6	0.8	3.3
Hispanic Ethnicity	1.1	0.7	1.7
Insurance (private reference)			
Medicare	1.4	0.9	2.0
Medicaid	0.8	0.4	1.4
Self-pay	1.6	1.01*	2.5
Other	1.3	0.6	2.8
Urban	1.5	1.03*	2.2
Northeast (reference)			
Midwest	1.2	0.8	1.8
South	0.6	0.4	0.95*
West	1.0	0.7	1.5
Time (12:00-08:00 h reference)			
08:00-16:00 h	0.7	0.4	0.95*
16:00-24:00 h	0.8	0.5	1.2
Weekend	1.0	0.7	1.3
Visit Type			
Mental health			
Anxiety	0.4	0.2	0.6
Mood	0.6	0.4	0.8
Psychosis	0.9	0.6	1.3
Substance	0.8	0.5	1.4
Suicide	1.6	0.97	2.8
Injury-related	1.8	1.2	2.8
Urgent	1.8	1.3	2.5
Admit	1.1	0.9	1.3

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Table 4—Multivariate logistic regression: Predictors of ambulance use among mental health patients
*where OR 95% CI was 1.0, 2 decimal places were presented (CI = confidence ratio; h = hours)

likely to use EMS after controlling for age, race, ethnicity, gender, urbanicity, region, insurance status, and other factors. The twin problems of ED and ambulance over-subscription have at least one common denominator: mental illness. Indeed, psychiatric problems already pose a known and serious population threat in the wake of terrorism and disaster.[47,48] Hence, any solution to this challenge will require a restructuring of the emergency mental healthcare system informed by those working in disaster management, psychiatry, emergency medicine, and prehospital care.

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Appendix—Assignments of mental-health related emergency department visits to DSM IV-compatible categories

1. *Mood disorders* (ICD/DSM-IV: 296-296.9; 300.4; 311) e.g., Major Depressive Disorder, depression not otherwise specified, dysthymia, bipolar, other mood disorders; and NCHS reason-for-visit 1110.0 (depression).

2. *Anxiety disorders* (ICD/DSM-IV: 300.00-300.61 except 300.4 dysthymia) e.g., generalized anxiety disorder, panic disorder, obsessive-compulsive disorder, post-traumatic stress disorder, acute stress disorder, agoraphobia, anxiety disorder not otherwise specified; and NCHS reasons for visit 1100.0 (anxiety and nervousness) and 1105.0 (fears and phobias).

3. *Psychotic disorders* (ICD/DSM-IV: 295-295.9, 297.3, 298.8, 298.9) e.g., schizophrenia, psychosis; and NCHS reasons for visit code 1155.0 (delusions or hallucinations).

4. *Substance-related conditions* (ICD/DSM-IV codes 290.44-292.94 and 302.89-305.98) e.g., Alcohol and other substance abuse; and NCHS reasons for visit 1145.0 (alcohol-related problems) and 1150.0 (abnormal drug usage).

5. *Miscellaneous disorders* (ICD-9 V-codes 61.1-71.09) e.g. adjustment disorders, problems in living; and NCHS Reason-for-Visit Classification 1130.0 (behavioral disturbances) and 1165 (other symptoms or problems relating to psychological and mental disorders not elsewhere classified).

6. In addition, because of the emergent nature of the condition, identified *suicide attempts/ideation* were coded as ICD-9 E codes 950-959; and NCHS reasons-for-visit 5820.0 (suicide attempt) and 5820.1 (intentional overdose).

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